Quantifying the Environmental Benefits of Green Power

Eighth National Green Power Marketing Conference Chicago, Illinois November 3-5, 2003

Alden Hathaway
Environmental Resources Trust, Inc.
&
Colin High

Resource Systems Group Inc.

Market Benefits of Quantification Why do we need to quantify?

- Renewable energy cannot get **clean air credit** without rigorous and accurate quantification of specific air emissions reductions achieved through renewable energy generation.
- Quantification gives renewable energy a **competitive edge** in The marketplace, by valuing its emissions reductions for NOx and other emissions trading opportunities
- In certain regional power markets, this empirical and quantitative approach focused on net emissions reductions achieved by the green power source generation can more effectively **spur green power market development** than the use of "average system mix" emission reduction estimates which include nuclear and large hydro plants that are not displaced by renewable generation

How?

Use the Power Plant Dispatch Ranking Methodology to measure NOx emission reductions and other reductions created through renewable energy back down of fossil plants on the margin.

Examples:

- EPA Innovative Measures/SIP credit
- CCX Emissions Trading
- Other Emission Credit Program

New ERT Environmental Report



ANNUAL ECOPOWER® ENVIRONMENTAL REPORT FOR THE CITY OF CHICAGO FOR 2002

21 February 2003

Table #: Annua / ScoPowerik Say (on reental Report for City of Chicago

Kes	al EcoPowe	rjR) Envisore Year En	nen silkap ding 1331		Sty of Citiza	ge.					
Sources of EcoPower											
	Biogas ¹	Biorges ²	Wind ³	Solar Died	Geo theory i	TOTA Water	Simali Hydio	Total All Sources			
EcoPower Generated (MWh)	81,100							81,158			
EcoPower Sold (MWh) ¹²	81,150			- 1	1	1	1	81,158			
		Extinated	Artinico	ions Siavin	ge from Gene	ut on of E	ооРожи"				
	Biogas ¹	filiony ss ²	Wind ³	Solar Died	Geo- theory i	Tolk Water	Small Hydio	Total All Sources			
Grandhouse Geses (15:00-equin) ¹⁰	1962/07			1	1	1	1	19,50,0			
Critimia Air Pollutants Ib) ¹⁰											
Sulfar dic side s ¹⁷⁶	64,19				1			64,99			
Niko ge e d is sid e** **	85,283				1	1	1	85,200			
Particulate matter ("Total" "	13,336			1	1	1	1	13,336			
Volatile (Fig. auto Comp.co. ede" "	4.19			1	1	1	1	4,19			
Touic Air Pollutants (port or so) (1b) ⁹⁸											
1. 3 - Eula dire nº*	1,00001				1		1	1.000			
Age sic**	130			1	1			130			
Done zoner **	31.17			1	1	1	1	31.0			
Cadrium **	1.39			1	1	1	1	1.39			
Chroniant*	190			1	1	1	1	3.90			
Cy seld of	84.75				1			64.75			
Dissiles and Farmer**	1,000004							1.0000			
Fioremid oby do *	7.80							7.85			
Lrad*	2.67							2.67			
Minimary**	7.00			-				7.00			
Note:	6.31							6.31			
Polycy cit. Oig an ic Ma 🖢 r "	1.06			-	-	-		1.00			
Ziec **	1.0				1			1.0			
Automobile greentrouse gars equiva leds											
Equivalent No. as \$ 4 displaced 10	11000							11891			

^{*} Indicases a criseria pollurant. ** Indicases a toxic air pollurant







Methodology

- Identify the generation displaced on the margin by must run renewable power with:
 - Information from utilities or the ISO
 - Recent past generation and Continuous Emissions Monitoring (CEM) data
 - Dispatch models and transmission constraint data
- Match renewable generation schedule with displaced generation dispatch schedule
- Determine emissions of the renewable energy generation (if any) and displaced emissions from CEMs to calculate net reductions

Results of Chicago Report

- Analysis shows that renewable energy backs down fossil fuel plants, coal, oil, gas rather than nuclear or hydro
- Renewable energy backs down fossil fuel plants because of zero or near zero marginal operating costs
- Analysis utilizes actual power plant dispatch ranking data – specific plants dispatched in order of economic cost

Results of Chicago Report

- Continued:
- Analysis compares actual power plant dispatch ranking data and actual continuous emissions monitor data to verify emission and operational changes
- Data based on continuous monitors are current vs. time lag (up to two years) with other methodologies
- Data in Chicago shows 2300 lbs CO2 per MWh vs. 815 lbs per MWh using "System Mix" calculation

How Chicago Methodology Can Help Decision Making about Clean Air

Table #: Annual ScoPower's Sint i			of 0	hicago							
Nec	al EcoPon s		rentsiRep ding 1331		Sty of Citiza	go.					
	Sources of EcoPower										
	Agm ¹	Bioruss ²	$Wind^2$	Solar Died	Geo theory i ⁿ	TOTA Water	Simali Hydio	Total All Sources			
EcoPower Generated (MWh)	81,198			1	1	1	1	81,128			
EcoPower Sold Millin ¹²	81,198			- 1		1	1	81,156			
	Estimated ArEmissions Savings from General on of EcoPower $^{\rm III}$										
	Biogas*	Biory or ²	Wind ¹	Siciar Dieut	Geo- theory!	Talk	Sinal Hydio	Total All Sources			
Greenhouse Gases (Ib 00-	1.FG 191,013,07			1	1	1	1	19,20,97			
Critisria Air Pollutants Ib) ¹⁶											
Station Straight 175	404,199			1	1	1	1	454.199			
Niko ge e dik sid e ^{r. **}	10,203			1	1	1	1	85,263			
Particular mater Total "	10,220			-		-	-	10,000			
Volatile O quelo Cony ou eth ^{o or}	4,19			1	1	1	1	4,19			
Tou ic Air Pollutants (present set [1b] ⁹⁰											
1. 3 - Eula dine n°°	1.000				1	1	1	1.0000			
Arts eld**	130			1	1	1	1	135			
Eine zoner **	31.0					1		31.0			
Cadelan **	1.39							1.39			
Chic elant*	3.90					1		3.90			
Cy sold o"	64.70							64.70			
Dissipo and Farmer's	1.00004					-					
Formula dry do "	7.85							7.85			
Loud"	7.00							7.00			
Marcay** Motor**	631							631			
	1.00							1.00			
Polycy old: Olg as ic bla to r ** Zlac ***	1:13						-	1:13			
Automobile greentraser garenquien inste											
Equivalent No. as \$ o displaced ⁷⁸	11,891	1	1	1	1	1	1	11,891			

^{*} Indicases a criseria pollurant. ** Indicases a toxic air pollurant

- **Use Power Plant Dispatch** Analysis methodology to validate NOx emission reductions created through renewable energy back down of fossil plants.
- For example: Use EPA **Stationary Source Voluntary** Measures Policy to provide SIP credit to NOx emission reductions.



Quantification of Emissions Reductions

- Prospective quantification- based on renewable plant specifications and existing plant dispatch scheduling for the past 12 months - used for marketing and revenue estimation and preliminary emissions reduction estimates.
- Retrospective verification –based on actual power produced and actual emissions reduction for the verification period – used to meet emission reduction credit requirements

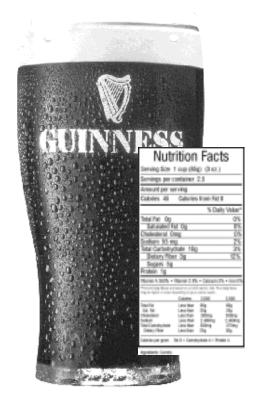
Environmental Attributes Represent a Product's Environmental Impact

As water has no calories, wind has no emissions and, thus, it's label is zero environmental attributes

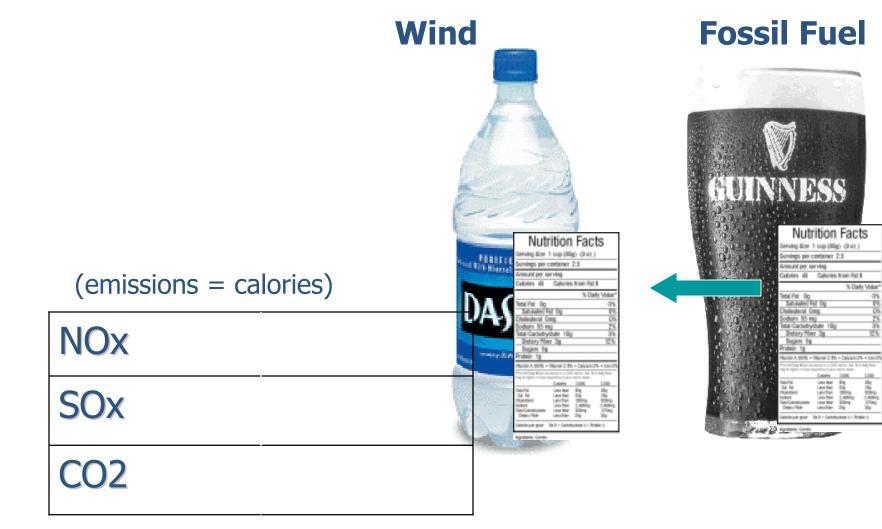
Wind



Fossil Fuel



However, Replacing Fossil Fuel with wind yields emission reductions



Steps in the Quantification and Verification Process

Common to Prospective and Retrospective Verification

- Obtain schedule of renewable power production- time of day / week / month
- Obtain list of conventional units on demand (operating on the margin) from load serving entity (utility).
- Verify the list of units on demand (operating on the margin) by reference to capacity factor, actual generation records or hourly CO2 CEM monitoring data on a sample basis.
- Determine demand schedule priority (back down order)

Steps in the Quantification and Verification Process

Continued

- Obtain emissions data from renewable source if relevant (e.g. landfill gas or biomass but not wind or PV) to calculate emissions / MWh
- Obtain emissions data and generation data for displaced units from CEMs for the relevant time periods to calculate emissions/MWh
- Determine net reductions in emissions attributable to renewable generation by time period.

Chicago Leads the Way



City of Chicago to begin purchasing over 120,000 MWh of Wind from Mendota Hills Wind Plant.

2 Largest Wind Plants in Midwest coming on line 2004.

Chicago Mayor Richard Daley receives a ceremonial EcoPower® Certificate from Commonwealth Edison CEO John Rowe.

New Wind for Chicago



Questions?

Alden Hathaway
Environmental Resources Trust, Inc.
Phone: 202-785-8577
ahathaway@ert.net
or
Colin High
Phone 802-295-4999
chigh@rsginc.com

Copyright Environmental Resources Trust, Inc. (ERT), 2003. Request to reproduce all or part of this material should be made to ERT.